Protection of Property Rights as a Unifying Theory for Agricultural Contracts

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The use of contracts for producing and marketing agricultural commodities has become nearly universal in some sectors and is increasing rapidly in others. For example, commodities such as broilers and processed vegetables have been produced almost exclusively under contract for decades; while contract use in commodities such as swine and (high-value) grains has increased rapidly in only the last decade. Still other commodities such as wheat and cotton are rarely produced under contract. In 1997, according to USDA, almost 33 percent of all agricultural commodities was produced or marketed under contract. In comparison, contracts affected just 11 percent of all commodities in 1993.

The academic literature and trade press has discussed many possible explanations for the increase in contracting as well as the many of the costs and benefits associated with contracting. Among the greatest disadvantages to farmers is a loss of managerial control (Featherstone and Sherrick, Hennessey and Lawrence). Along these lines, the trade press and news media has begun to report on diverse reactions to contracting among producers. For example, some broiler and potato producers feel exploited (Baltimore Sun, Richards et al.). Likewise, some small family livestock farmers complain that they receive lower prices than their larger competitors (Knight-Ridder, 3/4/2000). On the other hand, an Iowa State University survey indicates that many hog contractors indicated that they were satisfied with contracting (Hennessey and Lawrence).

Contracting benefits, however, may include a reduction in price risk (Hueth and Ligon) and increased financial leverage (Hennessey and Lawrence). Costs to contractors include those arising from asymmetric information, including monitoring and

contract enforcement while the benefits to contractors include assured supply and constant quality.

Many researchers believe that consumer preferences are driving the proliferation of agricultural contracts, in particular, production contracts. The rationale underlying this belief is that consumers have developed stronger preferences for specific qualities (Drabenstott). In response, manufacturers and other intermediaries have begun directly contracting with growers to ensure that they receive exactly the quality and quantity desired. Others argue that risk-aversion is the major factor driving contracting. Typically, producers are thought to be risk averse and intermediaries offering contracts (for example, processors) are assumed to be risk neutral. In a world of perfect and complete information, intermediaries would offer complete insurance against risk. Complete insurance gives rise to problems of moral hazard, suggesting that a constrained optimum will prevail in equilibrium, where processors offer contracts providing partial insurance.

Still others suggest that technological changes, and resulting economies of scale, drive contracting. Most technological change, the argument goes, is not scale neutral and leads to larger operations. While the unit cost of these larger operations may decline, they may lead to other adverse impacts, including increased risk exposure and strain on capital financing constraints. Should these consequences emerge, organizational and institutional changes may reduce the adverse impacts. In the hog sector, for example, Rhodes suggests that advances in technology, organization, and management have extended the feasible size of efficient production units. The driving force behind structural change in the hog sector, Rhodes states, has been the prospect of a stream of profits to those operators who seize new technologies and practices and develop new organizational structures to best complement them.

Market power is another explanation put forth. The traditional industrial organization literature has shown that coordination via contracts can provide the contractor with as much control as vertical integration (Tirole). Similarly, high levels of concentration at the processor (or first handler) level may give the processor monopsony power over producers. These kinds of issues have long been of concern in the livestock sector, particularly the meatpacking industry where the market share for the top four firms has risen to 82 percent (Azzam and Schroeter). More recently, attention has also focused on seed development companies. Many seed companies have merged (for example, DuPont and Pioneer Hi-Bred, and Monsanto's purchase of numerous firms), increasing market concentration, thus raising questions about market power of seed firms over producers.

In this paper, we argue that each body of literature has some validity and offers useful insights into agricultural contracts. At the same time, the current state of literature fails to provide us with a broad, unifying perspective on contracting. In addition, the literature does not include a comprehensive and systematic examination of factors causing transactions to switch from the spot market to contracts. This paper is our first step in an effort to fill in these gaps and offer a more comprehensive explanation for contracting. In doing so, we propose a broader look at contracts, one that examines a range of commodities yet is able to encompass each of the traditional strands of literature by utilizing a property rights rationale to explain variations in relative transaction costs.

The role of property rights and transaction costs

The conclusions economists draw when analyzing firm decision making are crucially dependent on the assumptions made about their environment. This idea is not new. Yet the degree to which we step out of the smoothly functioning world of Arrow-Debreu determines the way we think about firm decision making. The well-known

Coase theorem states that "In the absence of transaction costs, the allocation of resources is independent of the distribution of property rights". We use this theorem as our starting point for analyzing agricultural contracts. If we assume that transaction costs exist, then rational firms will consider these costs when making production and marketing decisions. In other words, firm decisions depend on the sum of both transformation (the costs of production and transporting goods to market[1]) and transaction costs (North and Wallis). Thus, when either transformation or transaction costs change, the firm's optimal decision will change also.

What exactly do we mean by transaction costs? The term is tossed about the literature, yet its meaning is not well-understood. One interpretation is that transaction costs result from the transfer of property rights. Another is that transaction costs are the costs of establishing and maintaining property rights (Allen, Barzel). When property rights are completely and perfectly specified, for example, it is not possible for someone to have unauthorized access to the good or rents from the good. If the rights are imperfect, however, it is possible for another party to capture some of the rents, forcing the owner to use resources to protect his rights over the good (Allen). Transaction costs include the cost of information, which includes the cost of determining product quality and enforcing an agreement (North). Thus, the standard asymmetric information problems (moral hazard, adverse selection, and contract incompleteness) are one kind of transaction costs. Yet the asymmetric information literature assumes that contracts are complete, meaning that every contingency is included in the contract.

Implicit in the complete contracting approach of the principal-agent literature is the notion that every possible outcome can be foreseen, and therefore, contracted over.

[1] The costs of getting goods to market could be considered a transaction cost, depending on how this cost is defined. For example, transportation costs are transformation costs (literally getting goods to market) but market research and search costs are transaction costs. Price setting could also be considered a transaction cost.

People may be boundedly rational, however, so that every outcome is not predictable (Simon). As a result, contracts may have holes or gaps making contracts incomplete. Some of the unexpected or not contracted for (including unenforceable) outcomes are possible because the good, or the quality of the good, both naturally varies and can be changed. Thus, identifying whether the undesirable outcome is a random act of nature or an act of fraud is impossible (Allen). It is in this space of unexpected, noncontractible outcomes where problems of property rights and transaction costs arise. The existence of transaction costs makes room for nonmarket rules, or institutions, to make transacting more efficient. Institutional innovation could include the emergence of social norms, contracting, vertical integration, inspection, or government regulation.

Relation to agricultural contracts

We suggest that a shift from spot market purchases to contracting is an institutional response to a changing mix of transformation and transactions costs. The shift may occur for numerous reasons, most often due to some technological innovation that lowers transformation costs. Some innovations may lead to an increase in scale, which in turn could increase risk exposure or capital requirements. Under a new operating environment, therefore, the new transactions may not follow the existing rules or practices. For example, technological change may lower costs of production, yet require a specific and uniform quality in order to take advantage of the lower costs of production. If the cost of obtaining the desired quality in the spot market is high, first handlers may begin offering production contracts. Substituting spot market purchases with contracting suggests that it is less costly to contract than to buy inputs in the market (Coase). On the other hand, changing consumer demand (in favor of specific levels of quality) can also raise the cost of obtaining the desired quality, suggesting a switch from spot market transactions to contracting.

Using this logic, we would expect contracting to take place in sectors where lower transformation costs have led to higher transaction costs. Specifically, these instances would include sectors where (a) quality matters, or where variation in quality matters, (b) quality is imperfectly observed in the spot market, (c) risk-sharing is possible, and (d) individual capital constraints are binding. This logic also suggests that some kind change needs to take place that makes the variation in quality matter enough so that first handlers become willing to offer contracts. In this environment, transaction costs arise from establishing and maintaining property rights in a setting characterized by incomplete or asymmetric information.

In order to make use of this framework, we define some of the transaction costs associated with agricultural production and marketing, and how they may have changed over the years. Agricultural producers face production risk (both farmer-specific and systemic) and price risk. Production risk refers not only to the quantity of output, but to quality as well. Buyers are necessarily constrained by the available quality and quantity in the market. When decisions are decentralized, the available quantity and quality depends, albeit stochastically, on producers. For spot market transactions, prices are determined by supply and demand.

Following Allen, we define transaction costs as the costs of establishing and maintaining property rights. One component of this is contract enforcement, which includes ensuring that all contract terms are satisfied (including quality specification, delivery, and payment). Thus, efforts by seed and life-science companies to enforce contract terms by preventing “illegal” seed saving can be viewed as transaction costs necessary to maintain the property rights associated with the seed. We argue that risk-mitigating activities can also be viewed in the transaction cost framework because they too are costs arising from the maintenance of property rights. Traditional models of production under uncertainty imply that producers choose their inputs prior to realization

of a random variable, such as weather or prices.[2] With uncertainty, the optimal output (and choice of inputs) results from producer utility maximization problem (Sandmo). Thus, we suggest that investment in irrigation equipment is an effort to maintain property rights over the crop, regardless of the realization of the random variable, such as the weather. Pesticide application also is an effort to maintain property rights over the crop, as pesticides are employed as to control damages rather than to increase production (Lichtenberg and Zilberman). In other words, the cost of both pesticide use and irrigation is a transaction cost because they protect property rights against damages.

The role of innovation and transaction costs

Technological change in production lowers marginal and average costs, but adopting new technology may require a large investment. For example, technological advances in the broiler industry included feed formulations, automatic feeding, and breeding, all of which led to larger flock sizes and lower transformation costs. Similarly, mechanical innovations in production (mechanical harvesting equipment) and in processing technology lowered costs of harvesting and processing vegetables, leading to larger farm size and lower transformation costs.

Larger flocks and farms meant larger capital requirements, which – coupled with declining and highly variable prices – made broiler operations and production of processed vegetables a risky business (Martinez, Reimund et al.). Part of the risk came from farms specializing in the production of these commodities. Larger feed companies soon offered and established production contracts with growers, thus assuring a market outlet for feed supplies in exchange for reducing growers' financial risks. Vegetable processors similarly began offering production contracts to growers. The use of production contracts increased quickly: in 1950, 95 percent of broiler producers were

[2] Exceptions to these types of traditional models include Chambers and Quiggin, Hirshleifer and Riley, and Peleg and Yaari.

independent (Roy, 1963; Martinez). Meanwhile, by 1955, only 10 percent of broiler producers remained independent, and by 1994, only approximately 1 percent of broiler producers were independent (Martinez). Growth in production contracting for processed vegetables was equally rapid, and in 1980, virtually all vegetables for processing were sold under contract.

Grower unwillingness to invest in costly capital with a specific use is not surprising, and is the classic asset specificity problem discussed by Williamson and Hart. In such a case, equilibrium is characterized by growers underinvesting in capital, and processors receiving a product that doesn't exactly meet their specifications (a transaction cost). For example, most vegetable and broiler processing equipment require inputs of uniform quality, both from one grower and across growers. For broilers, uniform quality is ensured through common genetics and proper management, including some operations—such as feed and water placement – that may sound trivial but can have an important impact on broiler quality. Contracting simultaneously circumvents hold-up and reduces processor transaction costs. The need for uniformity led to a shift in broiler contracts, from being offered by feed suppliers to being offered by processors. Because many contract growers supply a single processing facility, it is important for growers to supply uniform quality broilers, since uniformity is a necessity in automated processing plants.

Seed contracts, on the other hand, serve to preserve seed developers' intellectual property rights for new varieties, both for hybrids or genetically modified organisms. For example, high value grains (such as high oil corn) are inputs in the production of livestock. They serve as both grain and fat, eliminating the need for livestock producers to add oil to animal diets. High oil corn meeting specific standards (oil content in excess of 6%; field corn typically has an oil content of 3.5 – 4.5 percent) earns a premium in the market. The innovators of the seeds seek to maintain their

property rights over the stream of rents generated by their innovation. The innovations include technology that easily measures oil content, and seeds with high yield contents. Generally, the innovating firm (DuPont, for example) grants a license to seed companies. The contract specifies premium plus requires growers to provide evidence of "Crop Protection Products". Growers receive specification for best management practices for the crop they have.

In contrast, when high-oil corn is sold in the spot market, it's difficult for the innovator to secure property rights over the stream of rents accruing to the high value grain. In order to prevent producers or other intermediaries from sharing the rents, or for the value of the stream of rents to decline, contracts have strict provisions about storing and reselling seed. Another often used provision is that genetically modified seed cannot be carried over from one season to the next. To prevent this kind of 'seed piracy', Monsanto's seed contracts specify that farmers' fields can be inspected at any time over a three year period if they grow genetically modified soybeans, canola or cotton (Roundup Ready Gene Agreement), and the company has fined numerous farmers for violating this clause (DeVore).

All of the above examples have one thing in common: technological innovation has brought about increased transaction costs by specifically raising efforts to protect the property rights associated with a product. Property right protection costs, however, took many forms, including risk mitigation, quality assurance, and contract enforcement.

An example: The evolution of contracting in the broiler industry

In contrast to the diverse nature of other agricultural contracts, broiler contracts are fairly uniform across the industry. This may stem from the nature of broiler production, which has several characteristics that differentiate poultry farms from other U.S. farms. For instance, poultry farms are highly specialized: nearly half of all the poultry or eggs produced come from farms that exclusively specialize, and three-

quarters of all production comes from farms that produce only one other commodity besides poultry (Perry, Banker, and Green). Poultry production requires relatively little land, with the average poultry farm operating 134 acres, which is approximately one-third the size of the average U.S. farm.

In 1950, 95 percent of broiler producers were independent (Roy, 1963; Martinez). Meanwhile, however, technological advances in feed formulations, automatic feeding, and breeding increased the size of flocks and set the stage for integration and contract production. Larger flocks meant larger capital requirements, which – coupled with declining and highly variable broiler prices – made broiler operations a risky business (Martinez). In our transformation/transaction cost framework, therefore, it's clear that technological advances created economies of scale and lowered transformation costs. But these technological advances affected transaction costs as well as transformation costs.

In general, lower transformation costs in the broiler industry were associated with higher transaction costs as producers and integrators were forced to spend more to protect the now more valuable property rights associated with larger flocks and more expensive capital and feed formulations. Higher transaction costs, therefore, opened the door to contracting. Larger feed companies soon offered and established production contracts with growers, thus assuring a market outlet for feed supplies in exchange for reducing growers' financial risks. In our framework, feed companies, through contracting, could offer growers inexpensive risk mitigation while maintaining or protecting the property rights associated with their feed formulations.

After 1950, the use of production contracts increased quickly: by 1955, only 10 percent of broiler producers remained independent, and by 1994, approximately one percent of broiler producers were independent (Martinez). As the use of contracts developed, chicken processors replaced feed suppliers as primary integrators because

they stood to gain the most from coordinating supply and demand. In accordance with the property rights argument, processors gained more by protecting and maintaining the property rights associated with the final product than did the feed companies by protecting and maintaining the property rights associated with the feed.

Today, most major chicken processors control all the vertical stages in the boiler industry through integrated ownership or production contracts. These processor integrators breed the parent stock, produce the hatching eggs, and provide baby chicks, feed, veterinary services, and technical advice to growers under contract. Growers provide the chicken houses, litter, and labor. Over the years, however, broiler contracts have evolved to address or correct various economic obstacles – such as risky production, poor incentives to maintain high productivity, and large capital requirements – facing growers.

Martinez reports that the earliest broiler contracts, labeled *open account contracts*, merely eased the growers' capital constraints by extending credit. The integrators (who at the time were usually feed companies) made their profit by feed markups or by a flat service charge. Therefore, these early contracts did not shift any risk from producers to integrators, but they did lower transaction costs by making capital acquisition more accessible. According to Martinez, the next contract types – *guaranteed price contracts* and *flat-fee contracts* – guaranteed the grower a certain price or a flat fee per bird when the broilers were sold. The flat-fee contracts, which were widely used in the 1950's and 1960's, also reduced capital requirements because the integrator provided feed and other inputs while retaining title to the broilers. But whereas these contracts succeeded in shifting risks from the grower to the integrator, they also brought about certain incentive problems: specifically, they encouraged shirking by the growers. These contracts, therefore, lowered transaction costs associated with risk mitigation but raised transaction costs associated with moral hazard. To deter shirking,

Martinez says, *share contracts* gave growers a share in the proceeds of broiler sales (after integrator costs were netted out). Unfortunately, these contracts encouraged high input price markups by the integrator, and growers still faced large capital requirements and some incentive to shirk. By paying growers a bonus based on the amount of feed they used on a per-bird basis, *feed conversion contracts* addressed the incentive problem but still left growers vulnerable to production risk and capital constraints. Currently, *combination contracts*, which involve a flat-fee payment adjusted by a performance bonus, combine desirable risk and incentive properties of previous contracts. In addition, the bonus payment is based on the grower's performance relative to his or her peer growers rather than an absolute standard. This type of contract, therefore, provides a more optimal mix of risk-mitigating and moral-hazard mitigating transaction costs.

Conclusion

In this paper we have attempted to show how decisions to contract, like any other institutional innovation, can be comprehensively placed in a framework of transformation and transaction costs. More specifically, we have tried to show that when technological advances lower transformation costs, transaction costs sometimes increase. At the root of increase are extra costs associated with maintaining or protecting property rights either from increased risk exposure or from problems such as moral hazard and adverse selection associated with information asymmetries. We have identified how changes in the terms of broiler contracts were efforts to maintain property rights over economic rents.

Considering contracting as a response to a changing mix of transaction and transformation costs also brings in a dynamic aspect, by providing a rationale for a shift from spot market to contracted exchanges. Secondly, it's likely that a further exploration of these issues might also shed light on the seemingly non-uniform distribution of

contract benefits by addressing how the benefits and disadvantages to growers and contractors change over time. Or stated differently, we may investigate whether continual changes in transformation and transactions costs increase market power by first handlers (for example, processors, integrators, and shippers), leading to progressively less favorable terms over time from a producer's perspective.

Unlike other approaches to contracting, the property rights framework is extremely flexible in that it relies strictly on the firm profit-maximizing decision. The results are independent of both the risk preferences of the contracting parties and the characteristics of the commodities, which potentially gives our explanation great power. Our next steps are to examine the evolution of contracts in two other industries in great detail (high-oil corn and cattle), and to develop a formal model consistent with the evidence.

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